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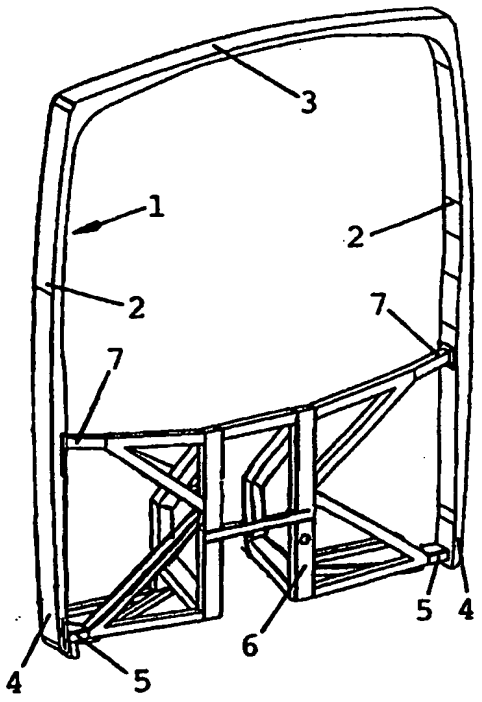
(57) Abstract

A bus provided with safety means (1) which protect the passengers in the bus from being trapped in case the bus should turn over or roll over. The safety means comprise a number of substantially vertically extending stiffening beams (2) of an elastic material, for example a composite material, which are connected to the side walls of the bus. The stiffening beams may form part of a roll–over bar, which extends the length of one side wall, the roof and the other side wall of the bus.



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AN OMNIBUS PROVIDED WITH SAFETY MEANS SUCH AS A ROLL-OVER BAR AND METHOD FOR THE ASSEMBLY OF AN OMNIBUS

The invention relates to a bus provided with safety means which protect the passengers in the bus from being trapped in case the bus should turn over or roll over.

Such safety means may be in the form of a roll-over bar, which prevents the space in which the passengers are present from being deformed to such an extent that said passengers will be trapped when the bus turns over or rolls over. It is usual, therefore, to make the roll-over bar as stiff as possible, in order to prevent it from being deformed by the large forces that occur when the bus turns over or rolls over.

In order to obtain sufficient stiffness the roll-over bar is usually formed from metal sections having great flexural stiffness, generally tubes having a circular cross section. The roll-over bar may be stiffened additionally near its corner points, and furthermore diagonally extending bars may be provided, all this in order to further increase the stiffness of the construction.

One drawback of such a roll-over bar is the comparatively great deal of space which the roll-over bar takes up, and furthermore its large weight, whereby it is moreover disadvantageous that the centre of gravity of the mass of the roll-over bar lies relatively high in the bus.

An object of the invention is to provide safety means for a bus, which obviate the above drawbacks.

According to the invention, in order to accomplish that objective, the safety means comprise a number of substantially vertically extending stiffening beams of an elastic material, preferably a composite material, which

are connected to the side walls of the bus, as a result of which a relatively light and elastic construction can be obtained instead of a stiff, heavy construction.

The invention constitutes a deviation from the prevailing view that a roll-over bar should hardly deform, if at all, when a vehicle turns over or rolls over. In particular when the passenger compartment of the vehicle is large enough, as is the case with a bus, there is no objection against a certain degree of deformation of said passenger compartment, as sufficient space will be left for the passengers in the passenger compartment in spite of said deformation.

By using a material which is considerably more elastic than metal, such as a composite material, a much lighter construction of the safety means will suffice, because on the one hand a large part of the energy that occurs is taken up by the elastic deformation of the composite material, whilst on the other hand the material is lighter than metal.

Preferably a stiffening beam is present on either side of the bus, near the front side as well as near the rear side of the bus. The stiffening beams may thereby form part of a roll-over bar which extends over a large part of the height of a side wall, the width of the roof and a large part of the height of the other side wall of the bus, whereby no diagonally extending parts are present, so that the elastic deformability, and thus the degree to which forces can be taken up, is increased.

The term roll-over bar used herein is understood to include the aforesaid stiffening beam, which may or may not form part of the roll-over bar, and the term stiffening beam used herein is to be understood to include a roll-over bar comprising two stiffening beams.

In one preferred embodiment the stiffening beams, at least a substantial part thereof, have a cross section which is considerably larger in the direction of movement of the bus than in the transverse direction. In this manner it is achieved not only that the stiffening beam or the roll-over bar only takes up a limited amount of space, but also that the elastic deformability in the transverse direction of the bus is increased, without the strength being essentially decreased as a result thereof.

Preferably the dimension of the stiffening beam in the direction of movement is twice as large, preferably four times as large, than said transverse dimension, at least locally.

In one preferred embodiment the stiffening beams form part of a roll-over bar, which roll-over bar has a horizontal part, whose central portion has a transverse dimension which is at least twice as small, preferably four times as small, as the transverse dimension of the other parts of the roll-over bar. When the bus rolls over or turns over, the force to be taken up at that place is limited, whilst the smaller transverse dimension provides more headroom in the bus.

Preferably a stiffening beam comprises glass fibres, more preferably bundles of glass fibres, which extend substantially in the longitudinal direction of the stiffening beam, and which are substantially incorporated in parts of the stiffening beam located near the outside surface thereof, on both sides of the stiffening beam, seen in the direction of movement of the bus. Furthermore the stiffening beam preferably comprises glass fibre mats, which may be woven or nonwoven mats, which extend round the stiffening beam, near the outside surface thereof. Said glass fibre mats, if they are woven mats, are preferably disposed in such a manner that the fibres extend obliquely, preferably at an angle of substantially 45 degrees, to the

longitudinal direction of the stiffening beam. In practice a roll-over bar of an epoxy resin or polyester comprising such a glass fibre reinforcement appears to provide an optimum effect.

According to another aspect of the invention the bottom end of the stiffening beam may be attached to the other parts of the bus in at least two spaced-apart places, which are located one above the other, said attachment being such that said bottom end cannot pivot and is capable of taking up a large torque in a transverse plane with respect to the bus. The two fastening points of the stiffening beam, which are located one above the other, or a vertically extending part of the roll-over bar, may be spaced a considerable distance apart thereby, for example more than 30 cm, preferably more than 50 cm, as a result of which a strong and reliable connection between the stiffening beam and the other parts of the bus will be maintained in case of a considerable deformation of the stiffening beam in a plane transversely to the direction of movement of the bus, since the forces being exerted on the spaced-apart fastening places decreases as the distance between said fastening places increases. In another preferred embodiment said distance is larger than 75 cm.

According to another aspect of the invention the stiffening beams are provided with fastening elements, which have been formed integral with the stiffening beam or the roll-over bar. When a roll-over bar is made of a composite material, fastening elements such as threaded holes and fastening flanges can be formed integral with the roll-over bar, without the strength of the roll-over bar being affected. Said composite material of the roll-over bar may also be provided with openings, which form ducts through which wires can be passed, whereby stiffening members can be provided at desired places in a simple manner.

Preferably said fastening elements comprise an edge extending in the direction of movement of the bus, on which wall parts of the bus can be attached, preferably by means of a glued connection.

According to another aspect of the invention a roll-over bar, which functions as an assembly frame for the front side of the bus, is present at the front side of the bus, whereby parts of the front side of the bus can be attached to the roll-over bar before the roll-over bar with the parts attached thereto is connected to the other parts of the bus as a preassembled unit. The roll-over bar of a composite material may be shaped such and be provided with fastening elements in such a manner that the roll-over bar can also function as an assembly frame, in particular because the roll-over bar is very strong.

According to another aspect of the invention a roll-over bar, which is integral with a three-dimensionally curved plate-shaped part which substantially forms the rear side of the bus, is present near the rear side of the bus. By forming said roll-over bar integral with the rear side of the bus, it becomes possible to use a lighter construction for the roll-over bar, because the rear side of the bus, at least part thereof, which is integral therewith, contributes to the required resistance against excessive deformation that may occur when the bus turns over or rolls over.

The invention furthermore relates to a method of assembling a bus, wherein parts of the front side of the bus are connected to a roll-over bar, which functions as an assembly frame, before said roll-over bar with the parts connected thereto is attached to the other parts of the bus. Also the rear side of the bus may be formed integral with a roll-over bar before said rear side is attached to the other parts of the bus. Such a method leads to a simplification of the

manufacturing process of a bus, and furthermore it contributes towards reducing the weight of the bus, since fewer fitting materials are required.

Further aspects of the invention, which may be used both separately and in combination with each other, are disclosed in the description of the figures and defined in the claims.

For a better understanding of the invention an embodiment of a roll-over bar of a bus will be described hereafter with reference to the drawing.

Figure 1 shows a roll-over bar which is attached to a part of the frame of a bus;
Figure 2 shows a roll-over bar and parts of the front side of a bus to be connected thereto;
Figure 3 shows a roll-over bar which is integral with the rear wall of a bus; and
Figure 4 is a cross-sectional view of a stiffening beam.

The figures are merely diagrammatic representations of the embodiment.

Figure 1 shows a roll-over bar 1, which consists of two substantially vertical parts 2 and a substantially horizontal part 3 at the upper side. The roll-over bar has a substantially rectangular cross section all around, with the short side of the rectangle extending parallel to the plane in which the roll-over bar extends, which is a transverse plane of the bus. The roll-over bar is made of a composite material, which possesses a much greater elastical deformability than steel and which is furthermore considerably lighter than steel. The roll-over bar may be hollow or solid, and it is preferably provided with a foam core.

Near its downwardly extending bottom ends 4 the roll-over bar is attached, for example by means of bolts, to a part 5 of frame 6 of the bus. The vertical part 2 of roll-over bar 1 is connected to part 7 of frame 6 a considerable distance away from said bottom end 4. Also this connection may be a screw or bolt connection. Since the distance between parts 5 and 7 of frame 6 is relatively large, in particular more than 30 cm, preferably more than 50 cm, a fixation of vertical part 2 of roll-over bar 1 to frame 6 of the bus is obtained, whereby vertical part 2 is capable of taking up large forces in the plane of roll-over bar 1. Frame 6 of the bus is a stiff structure, in particular as a result of the use of diagonal transverse connections.

Since roll-over bar 1 possesses a high degree of elastic deformability, in particular in a transverse plane of the bus, a relatively large amount of energy can be taken up under elastic deformation when the bus turns over or rolls over, whilst the roll-over bar is of relatively light construction. In the case of a bus it is not problematic thereby that the space accommodating the passengers will be slightly smaller, since a relatively large space is available for the passengers.

Figure 2 shows the front roll-over bar 1 of a bus, which roll-over bar also functions as an assembly frame for parts of the front side of the bus. Since roll-over bar 1 is made of a composite material, the roll-over bar can be provided in a simple manner with fastening elements 20, 21 formed integral therewith. Fastening elements 21 function to secure the roll-over bar to the frame of the bus, and fastening elements 20 are made in the form of a moulded edge for securing the various parts of the bus thereto. This makes it possible to use the roll-over bar as an assembly frame for said parts, for example the parts shown in Figure 2. Figure 2 shows the front part of roof 8 of the bus, frame 9 of the windscreen, a three-dimensionally curved front

plate 10, a portion of side wall 11 and a floor portion 12, which also comprises steps 13, via which the passengers can board the bus. All these parts can be attached to roll-over bar 1 before roll-over bar 1 is mounted in frame 6 of the bus. The advantage of assembling a bus in such a manner is that the various components to be assembled can be finished to a considerable degree before these parts become difficult to gain to, due to the fact that there is only limited room in and round the bus.

Figure 3 shows the rear side of the bus, which can likewise be attached to the other parts of the bus in the form of a preassembled component. The rear side shown in Figure 3 consists substantially of a three-dimensionally shaped part 16 of the rear wall of the bus. Part 16 is integral with a roll-over bar 1 of the kind described above with reference to Figure 1. Rear roll-over bar 1 may be of relatively light construction, since it derives part of its strength from rear wall 16 of the bus, which is integral therewith.

In Figure 3 roll-over bar 1 is integrated in rear wall 16, which is provided with elements 18 for fastening the back seat of the bus thereto, and with an opening 19 for a window. Roll-over bar 1 is indicated by dashed line 22 in the figure.

Figure 4 is a cross-sectional view of a stiffening beam 2, or the horizontal part of roll-over bar 1. Central part 30 of stiffening beam 2 is hollow or provided with a foam core, seen in cross-sectional view it comprises a length which amounts to about four times the width. Central portion 30 is surrounded by a tubular layer 31 of a plastic, for example epoxy resin or polyester. Incorporated in the plastic are bundles 32 of glass fibres, which are indicated by circles in the figure and which extend in the longitudinal direction of stiffening beam 2, that is, perpendicularly to the plane of the drawing. Said bundles

32 are only incorporated in the long sides of the cross section.

Furthermore glass fibre mats 33 are indicated by a dashed line in Figure 4. Glass fibre mats 33 extend over the entire circumference of stiffening beam 2, and also into the flanges or edges 34 which are present on either side of stiffening beam 2. Other parts, in particular wall parts, can be attached to said edges, preferably by means of a glued connection. Glass fibre mats 33 are preferably woven mats; the glass fibres preferably extend at an angle of approximately 45 degrees to the plane of the drawing.

Layer 31 of plastic material may comprise several layers of glass fibre mats 33 and/or glass fibre bundles 32, but for the sake of clarity they are not shown in the Figure.

The illustrated embodiment is to be considered as merely an example, several other manners of implementing the invention are possible.

CLAIMS

1. A bus provided with safety means which protect the passengers in the bus from being trapped in case the bus should turn over or roll over, which safety means comprise a number of substantially vertically extending stiffening beams (2) of an elastic material, which are connected to the side walls of the bus.

2. A bus according to claim 1, characterized in that said stiffening beams (2) form part of a roll-over bar (1) which extends over a large part of the height of a side wall, the width of the roof and a large part of the height of the other side wall of the bus.

3. A bus according to any one of the preceding claims, characterized in that said material is a composite material comprising a plastic, preferably epoxy resin or polyester, which is preferably reinforced with glass fibres.

4. A bus according to any one of the preceding claims, characterized in that said safety means are present near the front side as well as near the rear side of the bus.

5. A bus according to any one of the preceding claims, characterized in that said stiffening beams (2), at least a substantial part thereof, have a cross section which is considerably larger in the direction of movement of the bus than in the transverse direction of the bus.

6. A bus according to claim 5, characterized in that said stiffening beams (2) form part of a roll-over bar (1), which roll-over bar (1) has a horizontal part, whose central portion has a transverse dimension which is

at least twice as small, preferably four times as small, as the transverse dimension of the other parts of the roll-over bar (1).

7. A bus according to any one of the preceding claims, characterized in that a stiffening beam (2) comprises glass fibres, preferably bundles of glass fibres, which extend substantially in the longitudinal direction of the stiffening beam (2), and which are substantially incorporated in parts of the stiffening beam (2) located near the outside surface thereof, on both sides of the stiffening beam (2), seen in the direction of movement of the bus.

8. A bus according to any one of the preceding claims, characterized in that a stiffening beam (2) comprises glass fibre mats, which may be woven or nonwoven mats, which extend round the stiffening beam (2), near the outside surface thereof.

9. A bus according to claim 8, characterized in that woven glass fibre mats are disposed in such a manner that the fibres extend obliquely, preferably at an angle of substantially 45 degrees, to the longitudinal direction of the stiffening beam (2).

10. A bus according to any one of the preceding claims, characterized in that the bottom end of the stiffening beam (2) is attached to the other parts of the bus in at least two spaced-apart places, which are located one above the other, said attachment being such that said bottom end cannot pivot in a transverse plane with respect to the bus.

11. A bus according to any one of the preceding claims, characterized in that said stiffening beams (2) are

provided with fastening elements, which have been formed integral with the stiffening beam (2).

12. A bus according to claim 11, characterized in that said fastening elements comprise an edge (20) extending in the direction of movement of the bus.

13. A bus according to any one of the claims 2 - 12, characterized in that a roll-over bar (1), which functions as an assembly frame for the front side of the bus, is present near the front side of the bus, whereby parts of the front side of the bus can be attached to the roll-over bar (1) before the roll-over bar (1) with the parts attached thereto is connected to the other parts of the bus as a preassembled unit.

14. A bus according to any one of the claims 2 - 13, characterized in that a roll-over bar (1), which is integral with a three-dimensionally curved plate-shaped part which substantially forms the rear side of the bus, is present near the rear side of the bus.

15. A roll-over bar as defined in any of the claims 2 - 14.

16. A method of assembling a bus, wherein parts of the front side of the bus are connected to a roll-over bar (1), which functions as an assembly frame, before said roll-over bar (1) with the parts connected thereto is attached to the other parts of the bus.

17. A method of assembling a bus, wherein the rear side of the bus is formed integral with a roll-over bar (1) before said rear side is attached to the other parts of the bus.

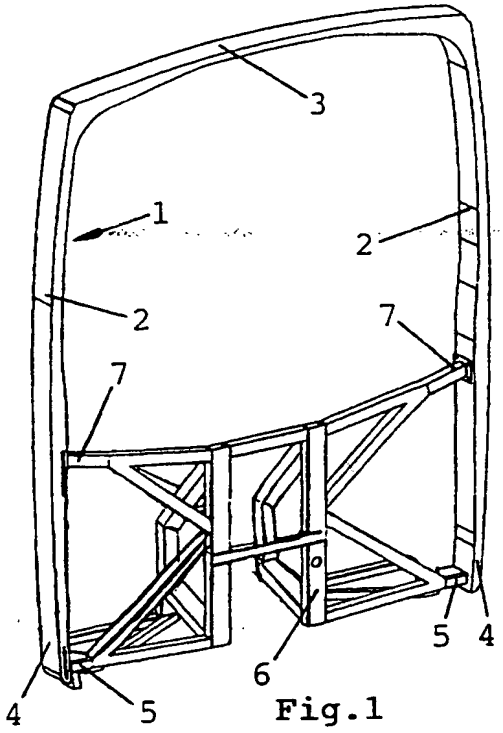


Fig.1

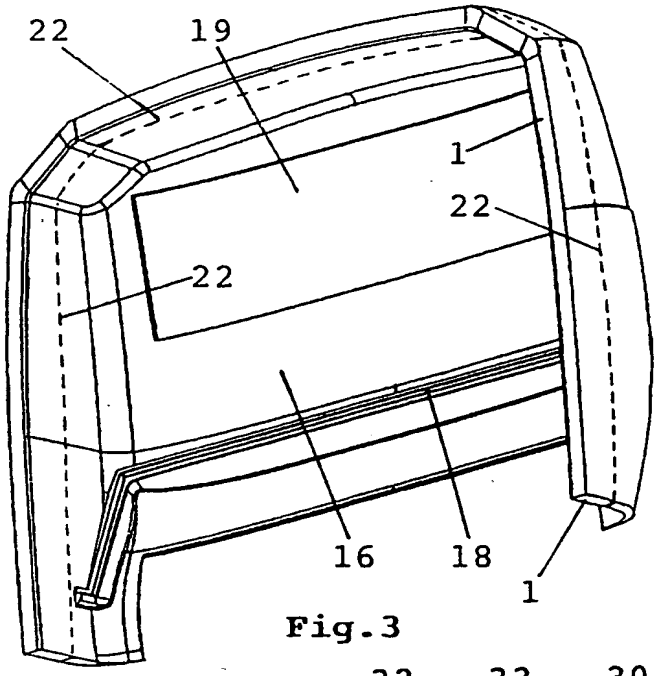


Fig.3

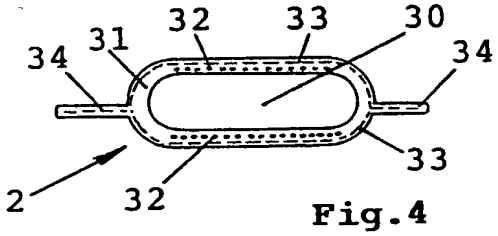


Fig.4

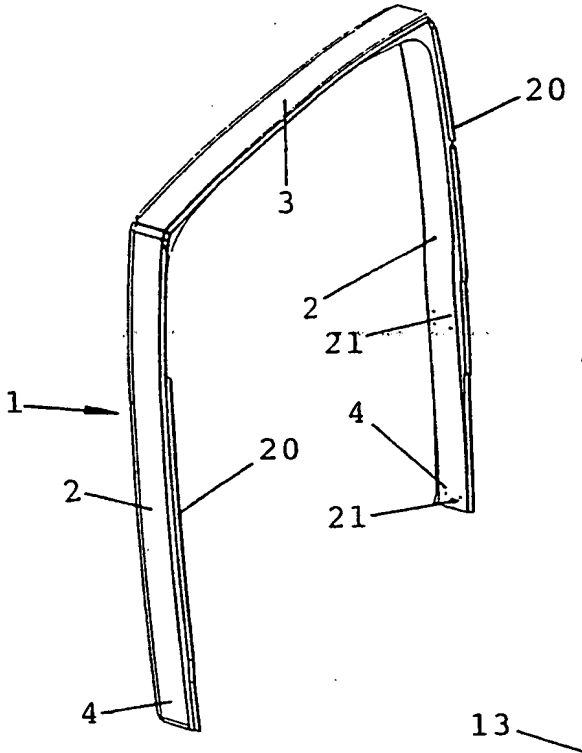
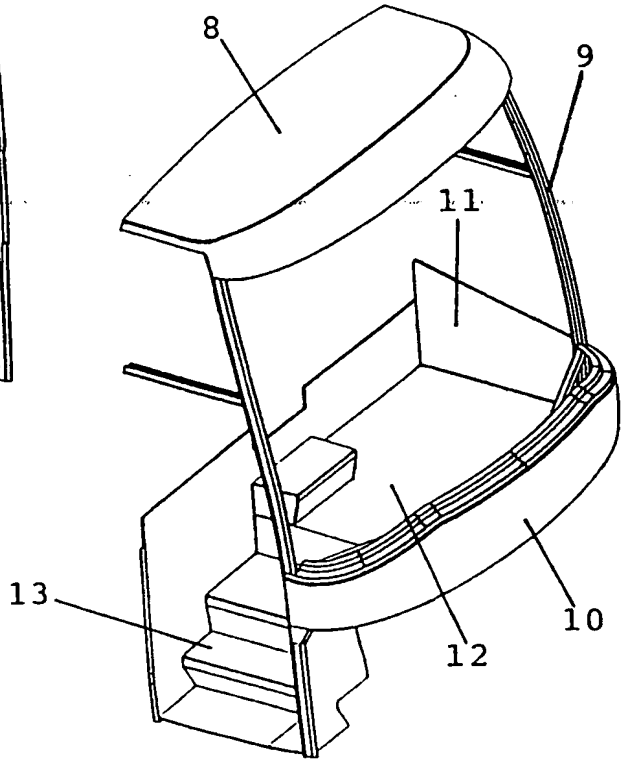


Fig.2



INTERNATIONAL SEARCH REPORT

Int. ional Application No
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A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 B62D31/02 B60R21/13

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 B62D B60R

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category '	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	FR 2 373 433 A (HEULIEZ SA LOUIS) 7 July 1978 see page 2, line 37 - page 4, line 10; figures	1,2,4,5, 10
A	GB 1 349 844 A (MOULTON DEVELOPMENT LTD) 10 April 1974 see page 3, line 76 - line 84; figures	1
A	US 3 926 100 A (BERMANSEDER ROBERT ET AL) 16 December 1975 see column 2, line 15 - line 45; figures	1
A	EP 0 489 294 A (INVENTIO AG) 10 June 1992 see column 3, line 25 - column 4, line 26; figures 1,2	3

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
12 March 1998	25/03/1998

Name and mailing address of the ISA	Authorized officer
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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 066 067 A (FERDOWS HOUSHANG) 19 November 1991 see column 3, line 38 - line 53; figures 1,6	3,7-9

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